

GATEWAY Demonstrations: What Have We Learned About LED Performance and Cost Effectiveness?



LIGHTFAIR
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- GATEWAY projects provide real-world field experience
 - Comparison of LED with incumbent technologies
 - Feedback for manufacturers
 - Objective information for municipalities, utilities, etc.
 - Tracking of year-to-year technological progression
 - Long-term performance monitoring
- GATEWAY projects strive to:
 - Save energy
 - Meet owner expectations or industry standards for lighting quantity and quality
 - Meet owner requirements for cost effectiveness

J. Paul Getty Museum exhibit:
In Search of Biblical Lands
Photo courtesy Getty Museum



- Museum display lighting – LED Retrofit Lamps
 - JSMA, Eugene OR (published September 2011)
 - Getty Villa, Malibu CA (published March 2012)
 - Smithsonian American Art Museum, Wash DC (est. May 2012)
- Ornamental Street Lighting
 - Sacramento, CA (published Dec 2011)
- LED Street and Roadway Lighting
 - FDR Drive, NYC, NY (published Dec 2011)
 - Cully Road, Portland OR (est. date June 2012)
- Hotel accent and downlighting – LED Retrofit Lamps
 - InterContinental Hotel, San Francisco, CA (updated January 2012)



Chris Jordan Exhibit "Running the Numbers"
Jordan Schnitzer Museum of Art, University of Oregon, Eugene OR



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Photo
courtesy
Jordan
Schnitzer
Museum of
Art

“Caps Seurat” - Depicts 400,000 plastic bottle caps, equal to the average number of plastic bottles consumed in the United States every minute.



Photo
courtesy
Jordan
Schnitzer
Museum of
Art

Source	Lamp Type	Total Watts	Energy Savings
Halogen	(49) 90W PAR38 25° NFL 130V (79W)	3871	
LED	(54) Cree LRP38 12W 20° NFL 2700K (10.2W)	551	86%

	Halogen	LED
Total Initial Cost	\$265.58	\$ 5832.00
Annual Hours of Operation	2548	2548
Operating Power of Lighting System	3871 W	551 W
Annual Ltg. Electric Operating Cost	\$591*	\$84*
Payback from Lighting alone (Years)	-----	9*
Payback from Lighting + HVAC (Years)	-----	7*
Lifespan (50,000 hrs/2548) Years		19.6

* Note: The JSMA pays only 6c/kWh for electrical power!



Viewing public's assessment of four light sources (% with strong preference) in test gallery



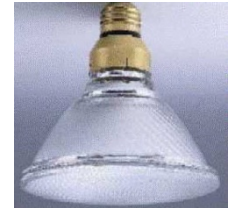
2700K, 84



2700K, 85



2638K, 93



2821K, 99

	LED Lamp 1	LED Lamp 2	LED Lamp 3	Halogen Par38 Lamp
Overall light distribution on art	0	23	8	23
Ideal warmness / coolness of light	10	37	12	8
Best lamp for oil painting	6	25	15	15
Best lamp for B&W photo	1	29	14	4



“In Search of Biblical Lands” Exhibit, The Getty Villa, Malibu CA (photo courtesy of The J. Paul Getty Museum)



Photo
courtesy
The J. Paul
Getty
Museum

Source	Lamp Type		Total Watts	Energy Savings
Halogen	(34) 60W PAR38 30° 120V		2040	
LED	(34) 12W LED PAR38 20° (10.2W)		347	83%

In Search of Biblical Lands Exhibit

	Halogen	LED
Total Initial Cost (Lamps only)	\$184.00	\$3398.00
Annual Hours of Operation	2652	2652
Operating Power of Lighting System (W)	2040	347
Annual Ltg. Electric Operating Cost	\$649	\$110
Payback from Lighting alone (Years)	-----	2.3*
Payback from Lighting + HVAC (Years)	-----	2.1*
Lamp Lifespan (25,000 hrs/2652) Years	-----	9.4

* Melded electric rate of 12c/kWh



Smithsonian American Art Museum.
Lighting and photography by Scott Rosenfeld



Smithsonian American Art Museum, Rose Gallery (Halogen lamps)
Lighting and photography by Scott Rosenfeld



Smithsonian American Art Museum, Rose Gallery (LED replacement lamps)
Lighting and photography by Scott Rosenfeld

Julie Walters and Sam Rose Gallery

	Halogen	LED
Total Initial Lamp Cost	\$466	\$5610
Annual Hours of Operation	4500	4500
Operating Power of Lighting System	4737 W	1296 W
Annual Ltg. Electric Operating Cost	\$2984*	\$816*
Payback from Lighting alone (Years)	-----	1.4*
Payback from Lighting + HVAC (Years)	-----	1.1*
Lifespan (25,000 hrs/4500) Years		5.6

*At 14c/kWh melded electrical rate

- Luce Center Gallery of Art – Existing system uses 50W MR16 halogen lamps on electronic transformers. Whole system is controlled by preset dimming system.



Photo Credit: Scott
Rosenfeld

So far, no MR16 LED replacement lamp can light the gallery without flicker or other poor performance.

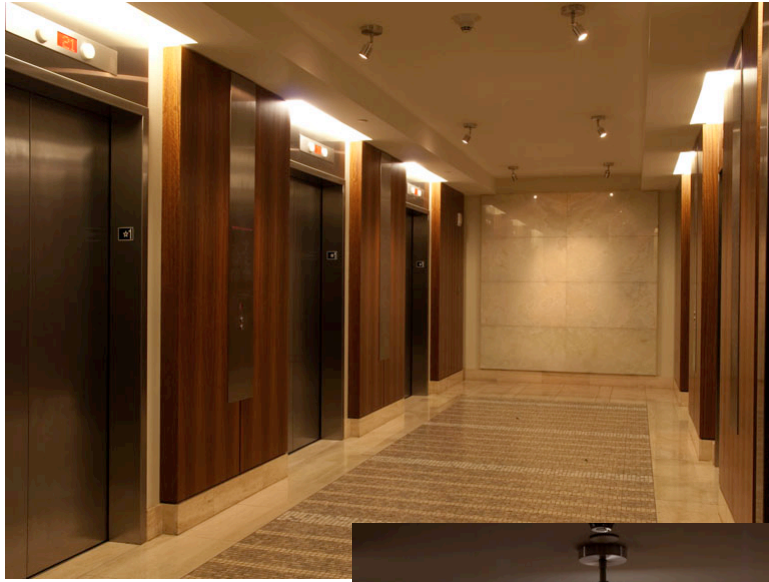
InterContinental Hotel, San Francisco, CA (Original work 2010)

- 6W LED replaced 20W and 30W halogen MR16
- 11W LED replaced 75W halogen PAR30
- 36 MWh annual energy savings, at \$0.13/kWh
- Simple payback period of 2 years
- Reduced maintenance

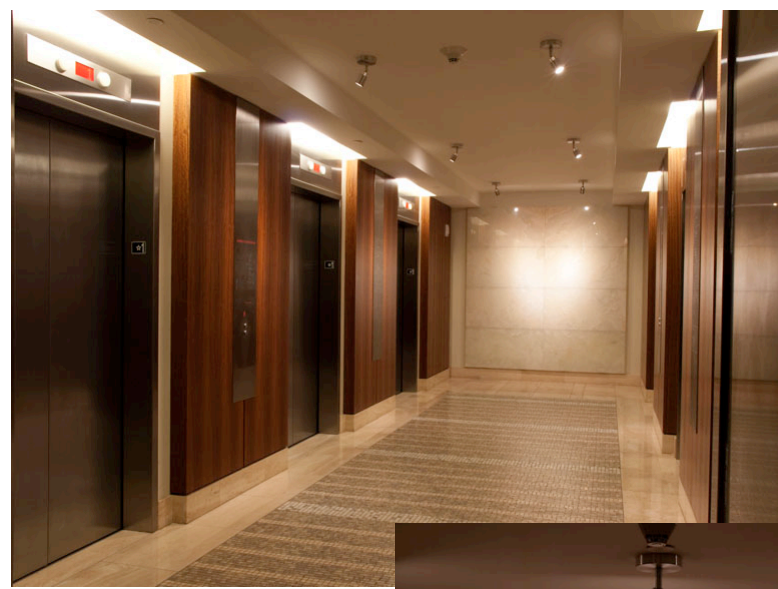


Photo Credit: Kenneth Rice

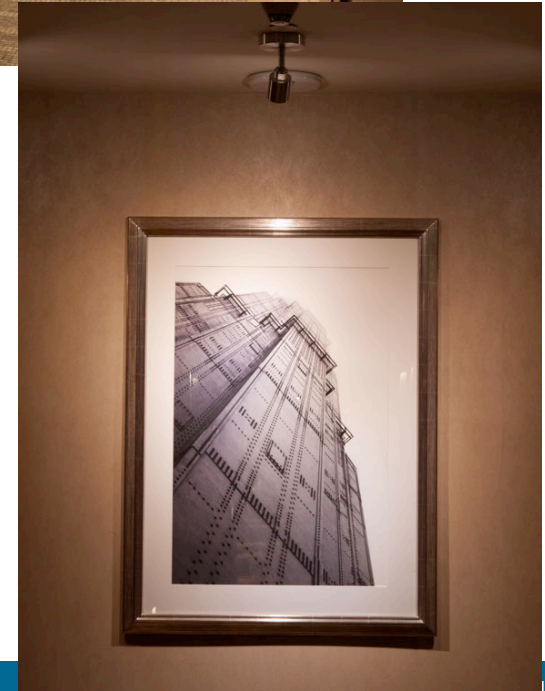
LED Hotel Retrofit Lamps



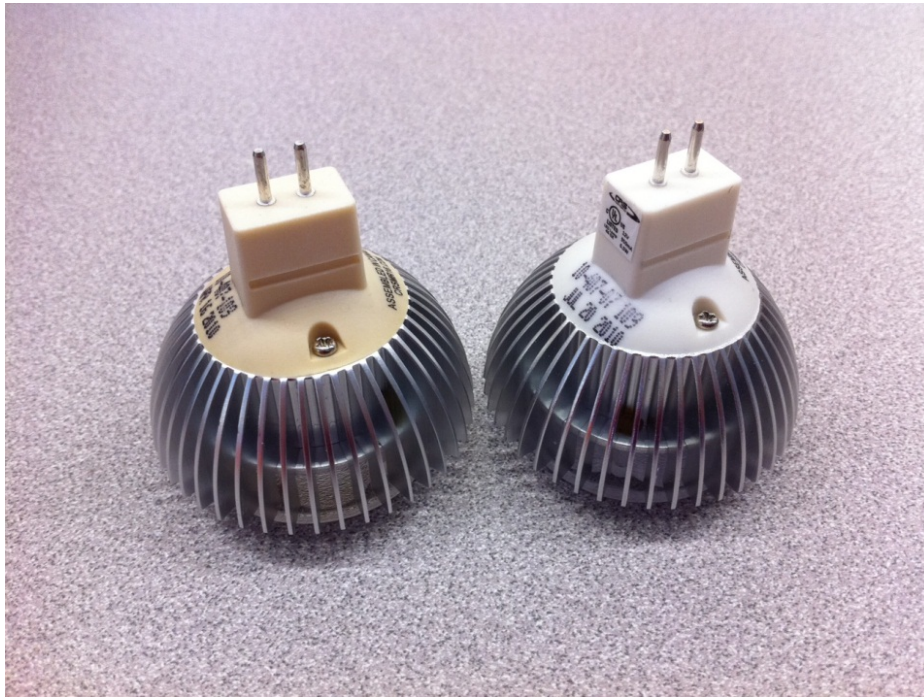
Halogen



LED



At 9000 hours of operation: LED lamps dropped in light output and flickered noticeably. Driver capacitors failed due to prolonged heat.



MR16 lamp on left shows discoloration from high temperature operation in existing enclosed fixture at right (measured at 97°C)

Solid-State Lighting

Solid-State Lighting

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Solid-State Lighting GATEWAY Demonstration Results

The U.S. Department of Energy (DOE) shares the results of completed solid-state lighting (SSL) GATEWAY demonstration projects, publishing detailed reports and briefs on completed projects, both available as Adobe Acrobat PDFs. The reports include detailed analysis of data collected, projected energy savings, payback analysis, and user feedback.

Technology briefs profile specific SSL technologies under consideration for GATEWAY demonstrations.

Completed Projects



LED Retrofit Lamps: Malibu, California

At the J. Paul Getty Museum in Malibu, 12W LED PAR 38 lamps replaced 60W halogen PAR 38 flood lamps on a one-for-one basis for a special photography exhibition. The LED lamps resulted in energy savings approaching 83 percent compared to the traditional halogen system; simple payback was estimated to occur between years two and three. (March 2012)

[Getty Museum Report](#)



LED Roadway Lighting: New York, New York

On Franklin D. Roosevelt Drive in New York City, LED luminaires from four different manufacturers were compared to the incumbent high-pressure sodium (HPS) luminaires and evaluated for relative light output and performance. Although energy savings ranged from 26 to 57 percent compared to the incumbent HPS, with a high potential for improvement in illumination quality, the report shows how life-cycle costs would need to improve to economically justify an investment in solid-state lighting for many roadway lighting applications. (December 2011)

[FDR Drive Report](#)



LED Ornamental Post-Top Street Lights: Sacramento, California

The DOE [Municipal Solid-State Street Lighting Consortium](#) evaluated four different LED replacements for existing ornamental post-top street lights in Sacramento using computer simulations, field measurements, and laboratory testing. The study was restricted to retrofit or integrated replacement products that would either fit into the existing acorn fixture, or be similar in daytime appearance. This challenge proved formidable, as the results indicate that none of the LED products evaluated would

http://www.ssl.energy.gov/gatewaydemos_results.html

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Questions?